WOOLEN AND WORSTED WARP PREPARATION

(PART 2)

DRESSING

INTRODUCTION

1. Dressing is the process of unwinding the yarn from the spools and arranging it in the form of *sections*, in which each thread has its proper place and is arranged parallel to the other threads. These sections are then arranged side by side on a large reel until a sufficient number have been obtained to form the entire warp. Sometimes, during the dressing, a suitable sizing compound is added to the yarn so that its strength is increased and the breakage of the warp in the loom reduced to a minimum. The machine through which the warp yarn is passed for the purpose of applying this size and to arrange the spools of yarn into sections of the warp is known as a *dresser*.

As it would be impracticable to handle at one time in the dresser the total number of threads necessary to form even a narrow warp and at the same time to properly arrange the ends and apply the sizing compound, the necessity of forming the warp in sections is apparent. The number of ends that are to form one section of the warp are therefore spooled and the spools thus prepared placed in a creel at the rear of the dresser. The yarn from these spools is then passed through the dresser, where the size is applied and the yarn dried, after which it passes to the large reel. When one section of the warp has been wound on the reel, the yarn is cut and another section of the same length wound on the reel beside the first section. This operation is repeated until the total number of ends and the total width of the desired warp is obtained.

DRESSERS

COMBINATION DRESSER

2. There are several types of **dressers,** varying principally in the method of drying the yarn after the application of the size. In the **combination dresser,** which takes its name from the method of drying the yarn, this is accomplished by the combined action of a heated copper cylinder and several banks of steam coils. Fig. 1 is a view of the general construction of the machine, while Fig. 2 is a section showing the passage of the yarn from the dresser spools in the creel to the warp reel.

3. Application of the Size.—The yarn passes from the dresser spools *a* through the reed *b*, which is known as the **tying-in reed,** and serves to separate each end of the section so that the spools can be properly tied in, and then between two light-running rolls *c*.

The sheet of warp threads next passes between the size roll *d* and the squeeze roll *p*, which is usually covered with cloth. Nearly half of the circumference of the size roll is immersed in the size contained in the size pan *e*, which is a narrow trough extending across the entire width of the dresser. The size is kept at the right temperature either by means of steam coils immersed in the size, or by making the size pan with a false bottom, thus forming a tight compartment underneath, into which live steam can be admitted. This latter arrangement is known as a *steam-jacketed size pan* and is, on the whole, preferable to the other method. The bottom, or size, roll brings up the size and applies it to the yarn as it passes between the two rolls.

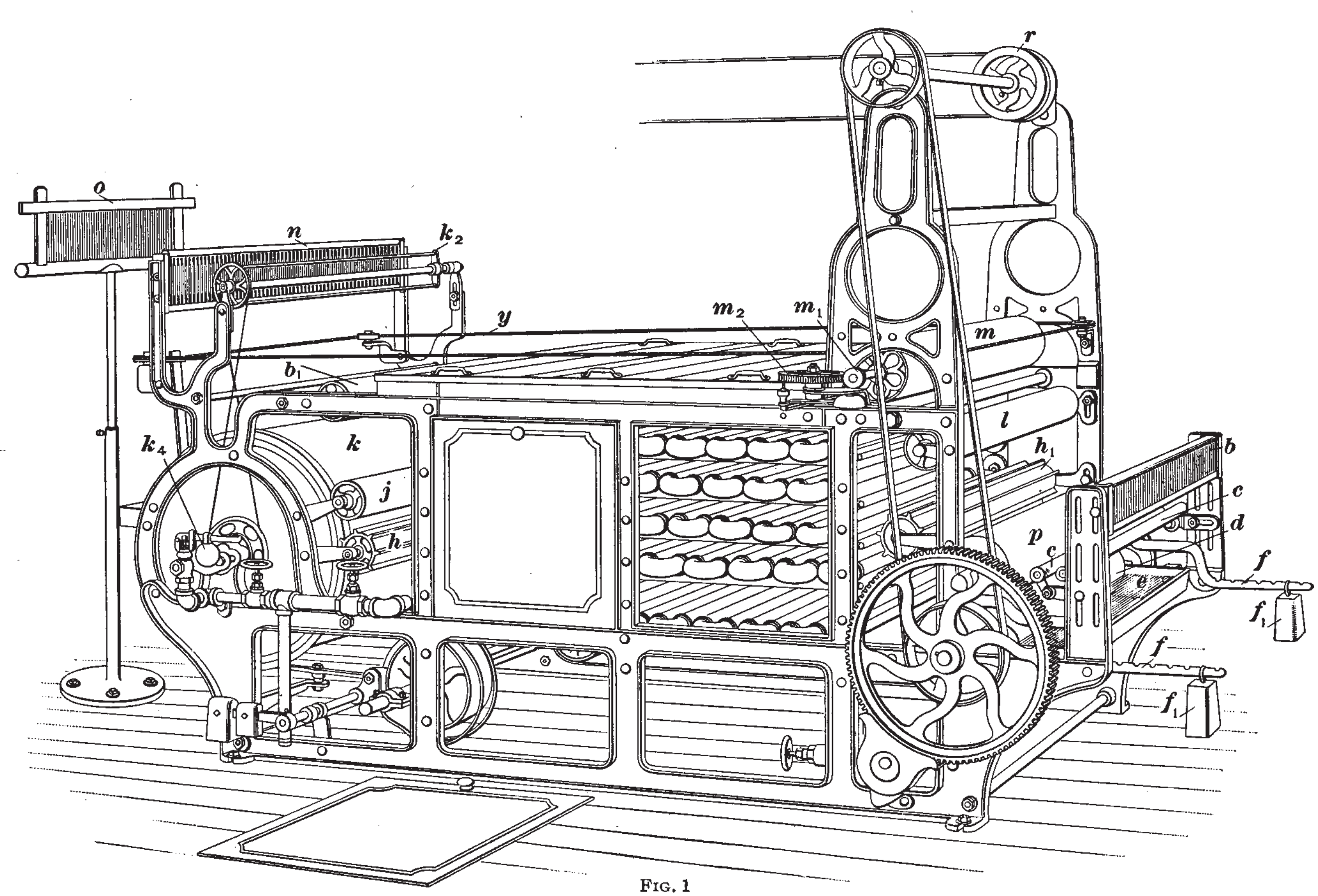

Fig. 1

The top roll acts simply as a squeeze, or press, roll to work the sizing compound into the yarn and at the same time to remove all the excess. The pressure on this roll is controlled by two levers f, one on each side of the machine; it may be regulated by means of the weights f_1, which if moved nearer the end of the lever will increase the pressure, and decrease it if set nearer the roll. Sufficient pressure should be applied to the yarn passing through the squeeze rolls to insure the removal of all the excessive size, which flows back into the pan over the surface of the roll d.

4. Drying.—After being sized, the yarn passes between coils of heated steam pipes to a skeleton roll h and then to another skeleton roll h_1, passing through the heated steam coils for the second time. Skeleton rolls are constructed with a number of projecting blades, on which the yarn rests. These extend the full width of the roll and prevent the yarn from touching any portion of the roll except the top of the blades. Their use is due to the fact that if the yarn while still moist and extremely adhesive by reason of the nature of the size applied to it were to come in contact with a smooth roll, there would be a tendency for it to stick and wind around the roll, thus causing a serious smash. This is very liable to happen if the machine is stopped for a time, since a stoppage allows the yarn to become securely attached to the rolls. As the yarn only touches at four or five points on a skeleton roll, there is no danger of this occurring, and, as it becomes somewhat drier in passing between the steam coils, the danger is entirely obviated and skeleton rolls are no longer necessary.

After passing around the skeleton roll h_1, the yarn passes back between the heated steam coils and then over a smooth tin roll j and around the steam-heated copper cylinder k. From the copper cylinder it passes through the steam coils again to a smooth tin roll l, and then back through the coils to another tin roll l_1. From this latter roll it finally passes over the steam coils and emerges from the dresser by passing around the measuring roll m; it then passes along the

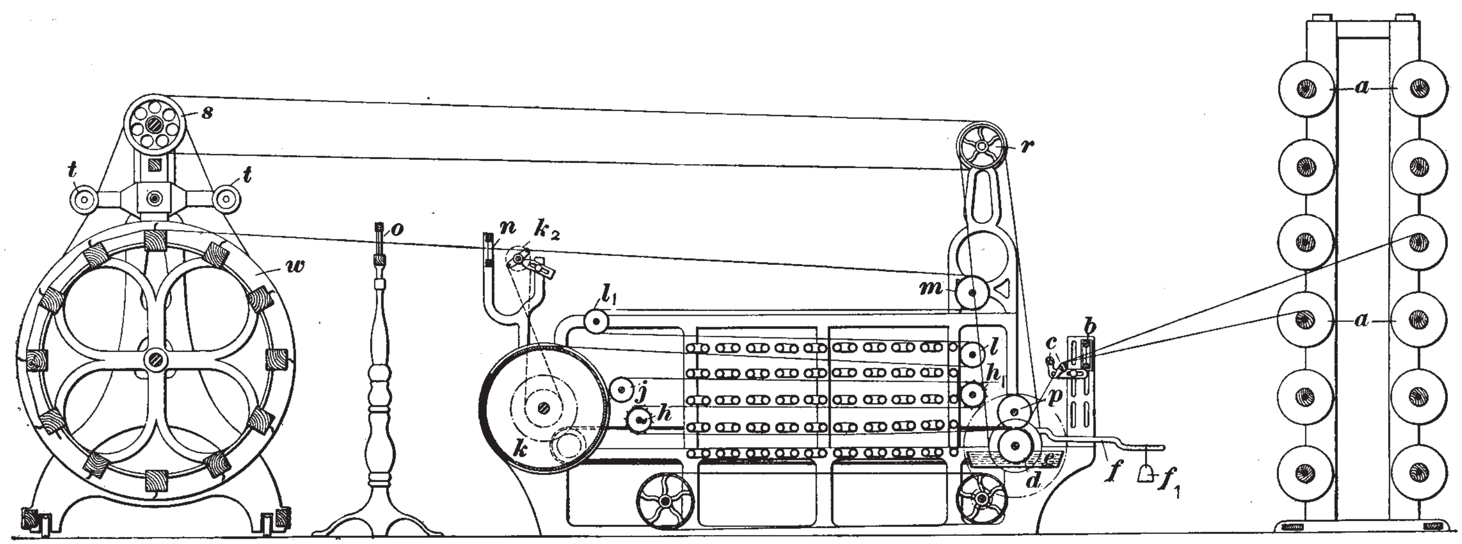

Fig. 2

top of the dresser, through the lease reed *n* and the condensing reed *o* to the warp reel, upon which the section of yarn is wound.

By this method the yarn is subjected to the heat of the steam coils six times after being sized, as well as being passed around the heated copper cylinder, so that the yarn is thoroughly dried before it is wound upon the reel. If it were placed on the reel while moist with size (which is largely composed of glue), the separate threads would become glued together and it would be practically impossible to weave or even beam the warp without an excessive number of broken ends, and even if it were woven, it would be a poorly running warp and would cause much trouble in the weave room. If a warp is not thoroughly dried, there is also great danger of mildew, which is a fungus growth caused by the damp condition of the yarn. When portions of a warp are mildewed, they cause spots in the woven cloth that it is impossible to remove.

5. The **combination dresser** is a very rapid dryer, as the heating capacity is large, consisting of five coils of steam pipe with eighteen pipes in a coil, as well as the large copper cylinder. It is sometimes built with eight coils of pipe and the length also may be increased indefinitely, allowing any number of pipes to be placed in a coil, so that the heating capacity is practically unlimited. Sometimes, when especially ordered, this dresser is built without the copper cylinder; in this case the yarn is dried simply by means of the steam pipes, and there is no doubt that this is to be preferred for dressing the very finest yarns.

The machine is arranged to be connected with a pipe from the boilers for the supply of steam, in which case a reducing valve should be used for reducing the pressure, or it may be connected directly to the steam-heating pipes. The pipes and copper cylinder of the dresser are tested with 40 pounds steam pressure before leaving the machine shop, but in practice a 15-pound steam pressure is sufficient for obtaining any results that may be desired, while dressers are ordinarily run with from 8 to 12 pounds pressure. It is provided with a safety valve k_4, which should always be kept in working order and set so as to blow off at the required steam pressure; otherwise, there is the liability of an explosion of the copper cylinder or the steam pipes.

The copper cylinder is also provided with an atmospheric valve, which admits air to the cylinder when the steam is turned off. This is necessary because as the cylinder is cooled a vacuum is formed inside by the condensation of the steam, and the pressure of the air on the outside tends to collapse the cylinder unless means are adopted for equalizing the internal and external pressures. The top and sides of the dresser are enclosed with wooden and sheet-iron coverings, which greatly aid in retaining the heat and consequently in the rapid drying of the yarn. It also increases the production of the machine, since, if dried rapidly, the yarn may be run through the machine faster. The comfort and efficiency of the operator are also promoted by enclosing the machine, since the covering furnishes protection from the intense heat. The side panels may be removed and the yarn exposed in order to piece up broken ends or for any other purpose. One of these panels is shown removed in Fig. 1.

6. Shaking Motion.—A **shaker,** or beater, is usually applied to dressers for the purpose of shaking the yarn just before it passes through the lease reed n, in order to loosen and free all threads that may be adhering to one another because of the adhesive nature of the sizing compound, so that they will pass freely through the reed without being broken. This device k_2 consists of two parallel rods fastened on opposite sides of a rotating shaft, and driven by means of a cord from a grooved pulley on the cylinder shaft. The sheet of yarn passing through the reed rests on the rods, which, in rotating, shake apart the ends that may be stuck together with size. This mechanism also prevents the yarn from wearing the lease reed in one place, thus greatly lengthening the life of the reed.

7. Measuring Motion.—The **measuring,** or **clock, motion** on the combination dresser is very similar to the one on the woolen spooler. On the shaft of the measuring roll m is a single-threaded worm m_1 that meshes with a dial, or clock, gear m_2 containing 120 teeth. The measuring roll is 18 inches, or $\frac{1}{2}$ yard, in circumference, so that one revolution of the clock gear will equal 60 yards of yarn passed over the measuring roll. There is a bell and hammer operated by a pin placed in the clock gear, as on the spooler.

8. Driving.—Beneath the dresser is a pair of cone pulleys by means of which different speeds may be given to the yarn as it passes through the machine; this regulates the time that the yarn is in contact with the heated air for drying, so that there is no need of keeping it in the machine longer than necessary nor of allowing it to be reeled in a moist condition.

The dresser has tight-and-loose pulleys 10 inches in diameter, which should be driven from 120 to 140 revolutions per minute. By means of a shipping device operated by an endless rope y running entirely around the top of the machine, as shown in Fig. 1, it is possible for the operator to stop the machine from either side.

TWO-CYLINDER DRESSER

9. In the **two-cylinder dresser** shown in Fig. 3, the principal feature of difference from the machine previously described is in the method of drying the yarn, which in this machine is accomplished by means of two copper cylinders k, k_1. It is claimed as a disadvantage of this machine that the yarn is injured by contact with the heated copper cylinders without having first been partially dried by steam pipes. A dresser of the two-cylinder type is, however, very convenient to operate, because of the greater facility afforded for piecing ends that break in the machine.

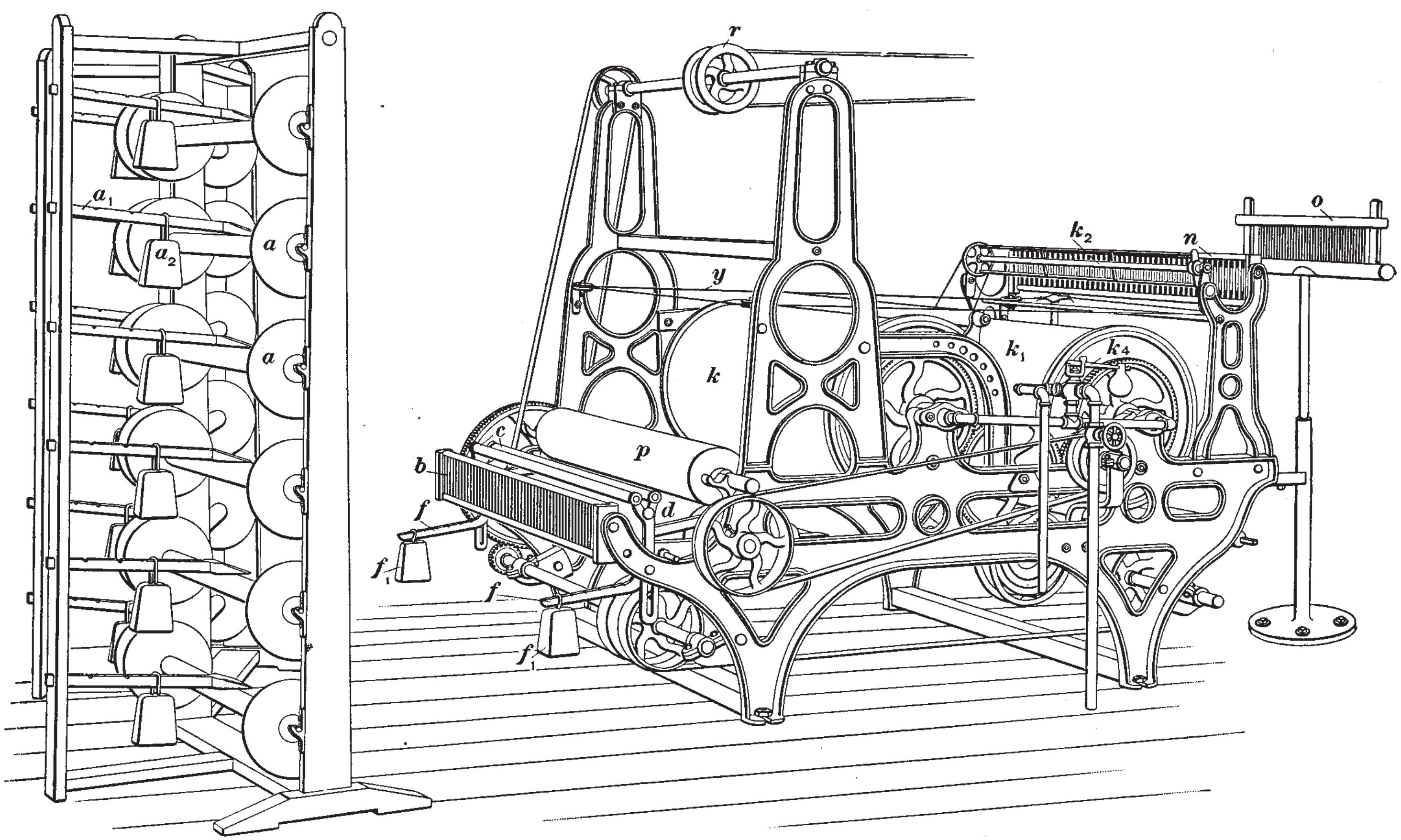

Fig. 3

FOUR-CYLINDER DRESSER

10. The **four-cylinder dresser** shown in Fig. 4 is similar to the two-cylinder machine with the exception that four copper cylinders k, k_1, x, x_1 are used for drying the yarn instead of two. The object of increasing the number of drying cylinders is to increase the capacity of the machine;

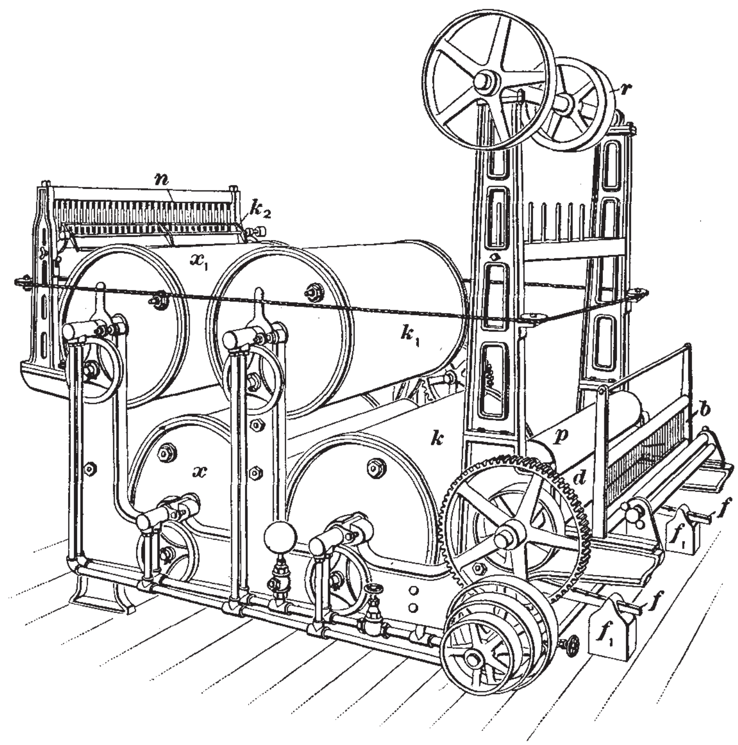

Fig. 4

the greater the heating surface, the faster may the yarn be dried and the more rapidly may it be run through the machine. There is no danger of mildew if the yarn is thoroughly dried before it leaves the dresser; but, on the other hand, it is detrimental to apply too much heat to the yarn, besides being an inconvenience to the operator. This latter point is more noticeable with cylinder dressers, which are open, than with the enclosed combination dresser.

SIZE

11. Size is not always applied to woolen yarn, and some mills rarely make use of any sizing compound whatever, claiming that it injures the brilliancy of the colors and is also disadvantageous because of the necessity of scouring it from the cloth in the finishing; the practice of sizing is becoming less common each year. On some yarn, however, there can be no doubt that the application of size is beneficial and actually necessary in order to give the yarn the strength required for weaving.

It will be understood that the constant chafing of the yarn in passing through the heddles on the harnesses tends to wear and weaken the yarn and break it; while the reed, in working forwards and backwards in beating up the filling, chafes the yarn even more than the harnesses. Very often on fibrous yarns the reed will scrape the loose fibers from each thread and collect them in *buttons* just behind the reed and in front of the harnesses. When these buttons grow large through the constant accumulation of loose fibers and the warp is drawn forwards by the take-up, the yarn will not be able to pass through the reed and so will be broken out.

It is the object of sizing to apply a mixture to the yarn that will fasten these loose fibers to the body of the yarn, thus not only increasing the power of the yarn to resist chafing but also actually increasing the strength of the yarn.

The substance generally employed as the base of sizing compounds for woolen yarn is glue. In the majority of mills pure glue and water are commonly used, the strength of the size being regulated by the character of the yarn to be treated. For instance, it would not only be unnecessary to apply a strong sizing compound to a yarn that requires but a weak size to lay down the projecting fibers, but it would be detrimental, because of the increased stiffness imparted to the thread. On the other hand, a weak, ragged yarn requires a strong size to give it the required strength for weaving. For a very strong size the glue may be used in the proportion of 2 pounds of glue to 3 gallons of water; a weaker size may be obtained by adding more water. With a little experimenting the exact proportion of glue that will give the best results with a given yarn may easily be found.

Tallow is sometimes added to the sizing compound in order to give the yarn softness, since the tendency of the glue is to render it somewhat stiff; not more than 1 pound of tallow to 50 or 60 gallons of size is necessary. When the proportion of glue in a sizing compound is reduced, corn starch is sometimes added to make up the deficiency. The following recipe has been found to make a good size for woolen yarn: 40 gallons of water, 12 pounds of glue, 7 pounds of corn starch, 1 pound of tallow.

In sizing worsted yarn—an operation that is rarely necessary—many manufacturers do not use any glue in the sizing compound, on account of the structure of a worsted yarn being such that there are practically no projecting fibers to be glued to the body of the thread. A size for a worsted yarn should also be one that may be easily removed from the cloth, as the finishing processes of worsted goods are generally less severe than those applied to woolen goods. The following recipe has been found to produce an excellent size for worsted warps; it may be altered in strength for different yarns by the addition of more or less water, as required: 50 gallons of water, 18 pounds of corn starch, 4 pounds of dextrine, $1\frac{1}{2}$ pounds of tallow.

The amount of sizing that the yarn receives is not only regulated by the strength or viscosity of the size but also by the amount of pressure on the press, or squeeze, roll of the dresser. Referring to Figs. 2 and 3, it will be seen that if the weights f_1 are moved nearer the ends of the levers f, the pressure that the roll p exerts on the yarn will be increased and the amount of size applied decreased, since the greater the pressure the greater will be the amount of size that is squeezed from the yarn and flows back to the size pan.

DRESSING FRAME

12. When warps are made without the application of any sizing compounds, instead of using a dresser and running it without heat and without the sizing arrangement, it is much more economical and convenient to use a **dressing frame.** With the exception of those parts that are necessary for sizing and drying the yarn, the dressing frame, as shown in Fig. 5, has all the essential features of a dresser—

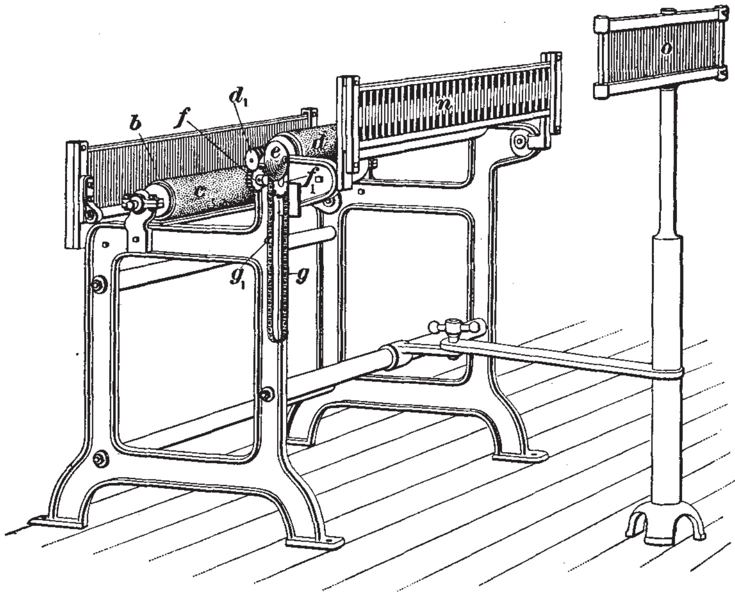

Fig. 5

a tying-in reed *b*, a measuring roll *d*, a lease reed *n*, and a condensing reed *o*. The yarn is taken from the spools in the creel, passed through the tying-in reed, under a leather-covered guide roll *c*, over the leather-covered measuring roll *d*, and through the lease and condensing reeds to the warp reel, upon which the sections are wound. By means of this frame the sections may be made, measured, and leased exactly as though the yarn was run through a dresser.

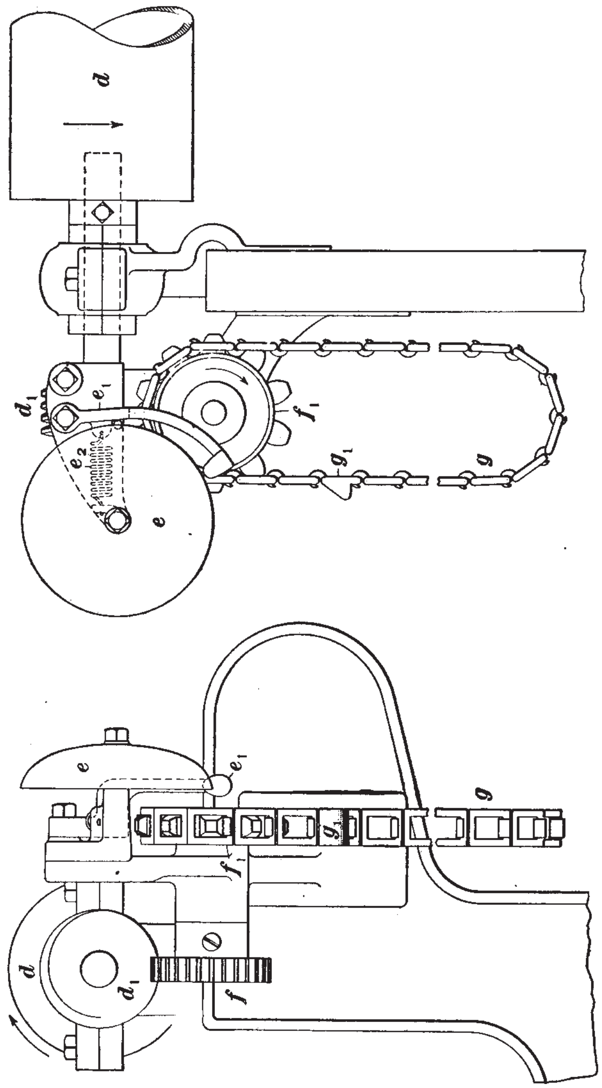

Fig. 6

At the same time, less floor space is occupied, and the machine is cheaper, simpler, and much more easily operated.

The dressing frame is provided with a **link measuring motion** for measuring the length of the sections; it is shown in Fig. 6, (*a*) being a side and (*b*) a front elevation. It is operated by the measuring roll *d*, which is given a rotary motion by the friction of the yarn passing over it. On the end of the measuring-roll shaft is a worm d_1 engaging with a worm-gear *f* fast to a short shaft, on the other end of which a sprocket gear f_1 is fastened. Running over the sprocket gear is a chain *g* composed of any desired number of links and containing one high link g_1, which in passing over the sprocket gear forces back and then releases a hammer e_1, which when released is drawn in contact with a bell *e* by means of a spring e_2. The measuring roll is 12 inches in circumference; the worm is single-threaded; the worm-gear has 30 and the sprocket 10 teeth. Therefore, three revolutions of the measuring roll will move the sprocket one tooth, or the distance of one link. Each link therefore equals 1 yard of yarn passed over the measuring roll; and the number of links in the chain, the number of yards passed through the machine.

SPOOL CREELS

COMMON CREEL

13. Fig. 3 shows a common type of *creel* for holding the spools of yarn made by the spooler. The **creel** consists of a wooden framework suitably constructed for holding the journals of the spools, so that the yarn may be readily unwound from them in being passed through the dresser. The most important point in connection with it is the method of applying friction to the spools so that they will hold the yarn at a suitable tension while it is being unwound. This is accomplished by means of a device consisting of a flat board a_1 from which a movable weight a_2 is suspended. The free end of the board rests on the top of the spool *a*, or rather on the yarn wound on the spool, while the rear end is loosely supported by the creel. The position of the weight determines the amount of friction on the spool, as the nearer it is placed to the spool, the greater will be the friction. This should only be sufficient to prevent the spools from running ahead when the dresser is stopped; yet it should be enough to make a smooth, level section. Instead of having a weight hung on the friction board as shown, the weight is sometimes placed on top of the board and arranged to slide in a groove, being fastened in any desired position by means of a thumbscrew.

Although the creel shown contains twelve spools, creels may be built to contain almost any number. Generally, instead of being semicircular in form as shown, they are built only the width of one spool and are arranged for two banks of spools, one behind the other. This arrangement is to be preferred, as it is more convenient when tying in the section and also mixes the yarn better, since the yarn from each spool can be distributed over the entire width of the section without straining the reed.

IMPROVED CREEL

14. In Fig. 7, a creel, or spool rack, is shown, which, although similar in its essential features to the one described, has a few points of difference. It is constructed entirely of metal, whereas the other was made of wood; the spools are contained in bearings in a double bank, and the yarn on the back spools in passing to the tying-in reed of the dresser is carried on two light-running rolls so that it will not interfere with the spools in the front of the creel. The principal feature of this creel is the method of automatically regulating the friction on the spool. When a spool is nearly full of yarn, it is turned much more easily by the pull of the yarn in unwinding, since the pull is then exerted on a larger diameter than when the spool is nearly empty. It will therefore be seen that in order to govern the friction on the spool so that the same amount of pull will be required to

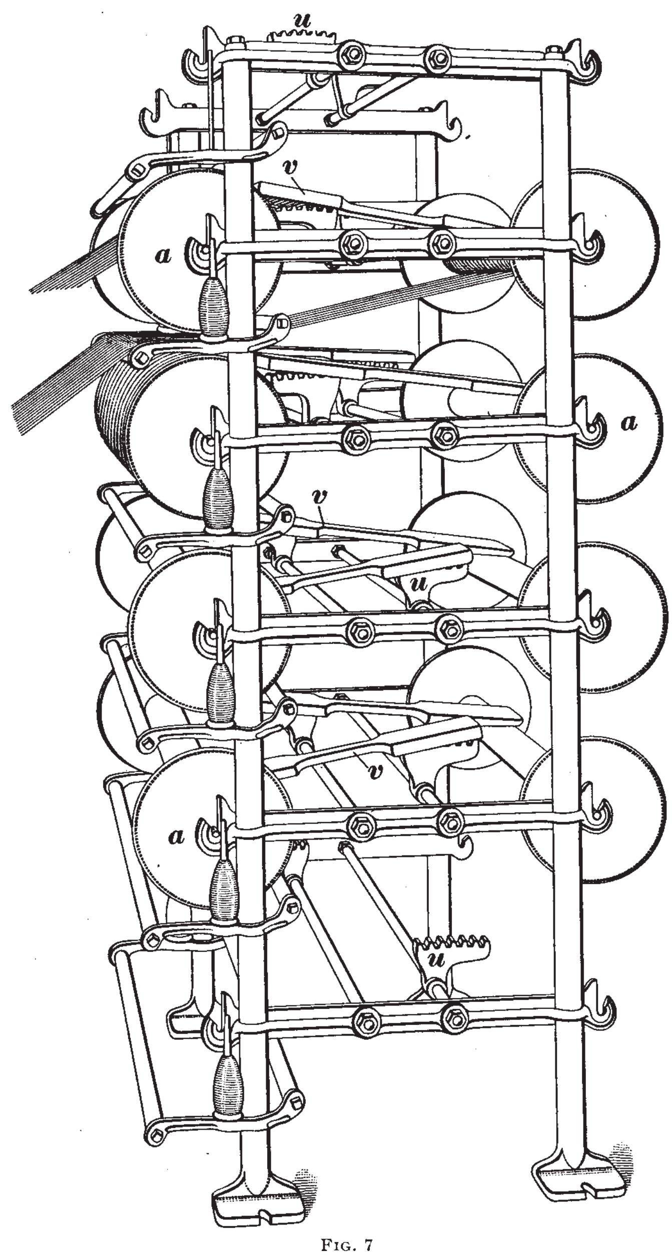

FIG. 7

turn the spool at all times, more friction should be placed on it at the start than when it is nearly empty. This is accomplished by means of a section gear *u*, Fig. 8. The friction lever, or tension paddle, *v* rests at one end on the spool *a* and at the other end on the section gear. Fig. 8 shows the position of the paddle when the spool is full and when it is empty. It will be noticed that in the former case more friction is being placed on the spool, since the tension paddle is then resting on the extreme end of the section gear. As the yarn is unwound from the spool, the fulcrum

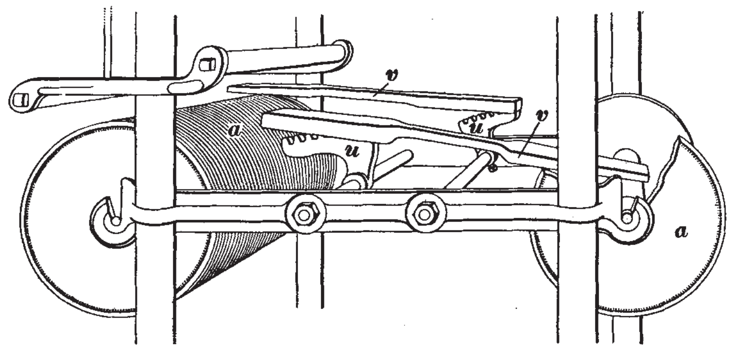

FIG. 8

of the tension paddle is constantly shifted toward the other end of the section gear, so that the friction on the spool is constantly decreasing. This, of course, is accomplished by the heavy-weighted end of the tension paddle counterbalancing the weight of the other end. The amount of tension may be easily regulated by loosening the setscrew that fastens the section gear to the rod and moving the section gear as desired. The tension may also be adjusted by simply taking off the paddle and replacing it in a different position on the section gear.

WARP REELS

PIN REELS

15. Sectional Warp Reel.—As the yarn leaves the dresser or the dressing frame it passes through a condensing reed and is then wound upon a large reel, as shown in Fig. 2. As only one section of the warp is made at a time, it is the object of the warp reel to arrange each section in regular

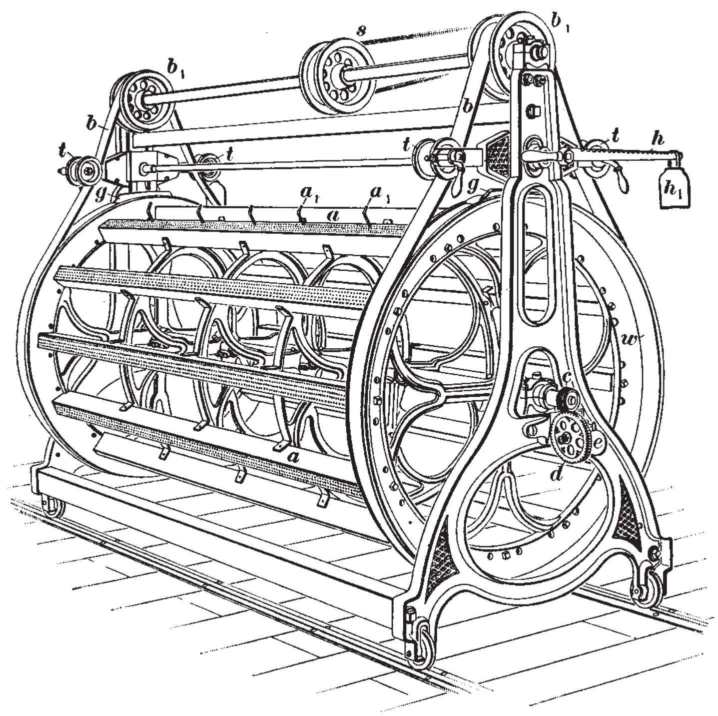

FIG. 9

order side by side until the warp is formed. Fig. 9 shows a sectional warp reel suitable for use in connection with a woolen dresser or dressing frame.

This device consists principally of a large reel *w* composed of twelve bars *a*, each of which is faced with a solid brass plate and drilled with four rows of holes, in which pins a_1 can be inserted for the purpose of separating each section and regulating the width of the section as it is wound on to the reel. The arrangement of the holes is such that an adjustment of $\frac{1}{8}$ inch may be obtained. The reel is driven by means of two belts b from the pulleys b_1 on the top shaft of the machine. This shaft, which is key-seated its entire length, receives its motion from a pulley on the dresser that drives the sliding pulley s shown in Fig. 9 (see also Fig. 2).

One of the principal features of a good warp reel is the **measuring device,** which measures the length of the sections so that the operator will be able to make each section the same. On the end of the main shaft is a single-threaded worm c that meshes with a worm-gear d so arranged as to ring a bell e, as in the case of similar devices used in connection with the spooler and dresser. The circumference of the reel is 4 yards and the worm is single-threaded; therefore, one tooth of the worm-gear is equal to 4 yards of the section wound on the reel.

One of the most essential features of the warp reel is the device for placing tension on the yarn when the finished warp is being beamed. Referring to Fig. 9, it will be seen that the driving belts b on each end of the reel pass under two tension pulleys t, which, with the brakes g that work on the heads of the reel, are controlled by means of the lever h upon which the weight h_1 is attached, as shown in the illustration, the lever and weight being duplicated on the other end of the machine, although not shown. While the sections of the warp are being wound on the reel, the tension pulleys are drawn together, thus tightening the belts and allowing the reel to be driven through the sliding pulley s from the dresser. This tightening of the belts is done by raising the weighted levers, which draw together the arms carrying the tension pulleys. When these levers are raised and fastened, the friction brakes are also raised from contact with the reel, both operations being performed by the single movement of the levers.

When, however, it is desired to unwind the yarn from the reel to the loom beam, it is necessary to place friction on the reel in order to obtain the necessary tension for winding the warp firmly. This is done by lowering the levers, which not only loosens the driving belt but also puts

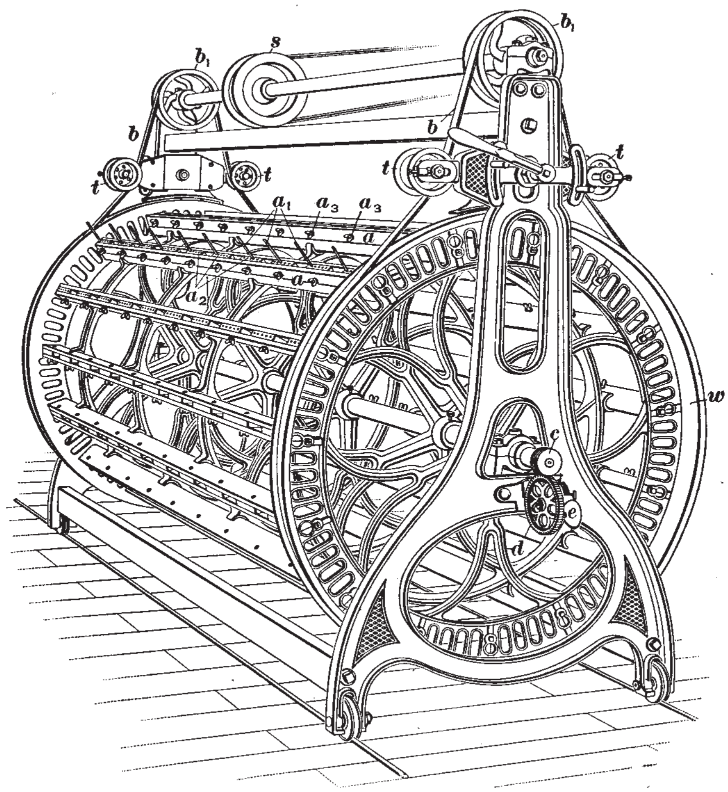

Fig. 10

the friction brakes in contact with the reel. The degree of tension can be regulated with great accuracy by means of the weights on the levers, which may be moved nearer or farther from the fulcrums. On many warp reels the friction, while beaming the warp, is obtained by means of ropes passing over the heads of the reel and having weights attached. This method, while not so convenient as the friction-brake arrangement, gives a more even tension. When beaming a warp, it is desirable to place the greatest tension on the yarn while the first part of the warp is being wound on the beam, in order that the succeeding layers of yarn may have a hard surface on which to rest.

A warp reel is always mounted on rolls or wheels that run on iron rails, so that the reel may be moved after one section of the warp is reeled, for the reception of the next section. The reel shown in Fig. 9 is built in two standard widths, viz., 92 and 111 inches, although other widths are built to order. The sliding driven pulley is $8\frac{3}{8}$ inches in diameter.

16. Patent Sectional Reel.—Fig. 10 shows a warp reel that is especially adapted for fine yarns and fancy patterns. The principal difference between this reel and the one described is in the method of adjusting the pins a_1 for the various sections. In this reel the pins are held in blocks a_2 that slide in grooves cut in the bars a of the reel. These blocks may be fastened in any position by means of thumbscrews a_3, so that the width of the section on the reel may be regulated with great exactness.

Another advantage of this device is that the pins are always in the center of the bar and not on one side; in the latter case the threads are liable to become crossed as the yarn is wound on the reel. When setting the pins on this reel it is convenient to use such a scale as is provided with the machine in obtaining the width of the sections.

PINLESS REEL

17. The **pinless reel** is designed to do away with the use of section pins, which not only require considerable time in being adjusted but also often cause the yarn at the edge of the section to be improperly wound during reeling; this results in the yarn being broken while it is being beamed. The machine shown in Fig. 11 consists of a heavy warp reel *c* mounted on a track and, in general, very similar to the warp reels described. The reel is driven by a belt running from the dresser to a large drum *d* instead of to a flange pulley, as is usually the case. Its peculiar feature is in the method of winding the yarn, each section being wound on the reel in a cone-shaped mass that is self-sustaining without the use of pins. Each bar of the reel, as shown in Fig. 12, has mounted at one end an adjustable coning iron *b*. The first section of yarn is wound on the reel at this end and

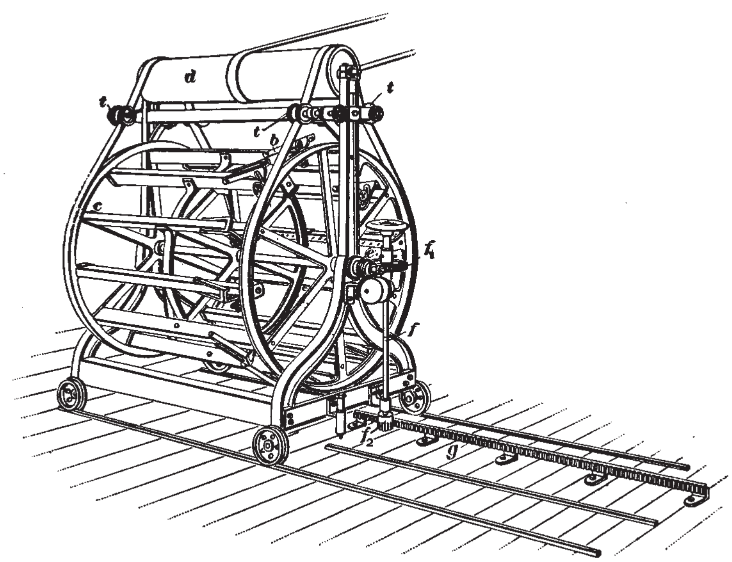

FIG. 11

as the reel is given a positive lateral motion while the section is being wound, the yarn mounts the coning irons and is wound in the shape of a cone. The section is started on the reel between the points x and x_1, but as the reel has a lateral motion to the left, the result will be that each succeeding layer of yarn will be moved slightly to the right, mounting the coning irons until the final layer of the section is wound between the points y and y_1. The position and shape of the first section of yarn wound on the reel is shown at *a*, while the dotted lines show the position of each succeeding section.

The lateral motion of the reel is obtained by means of a worm *e*, Fig. 11, that engages with a worm-gear f_1 fastened to a vertical shaft *f*; on the bottom end of this shaft a pinion gear f_2 engages with a rack *g* attached to the floor. As the reel rotates, this arrangement moves it on the tracks so that the yarn will mount the coning irons. The first section of yarn is built against the coning irons, as explained, but the next section wound on the reel is built against the first

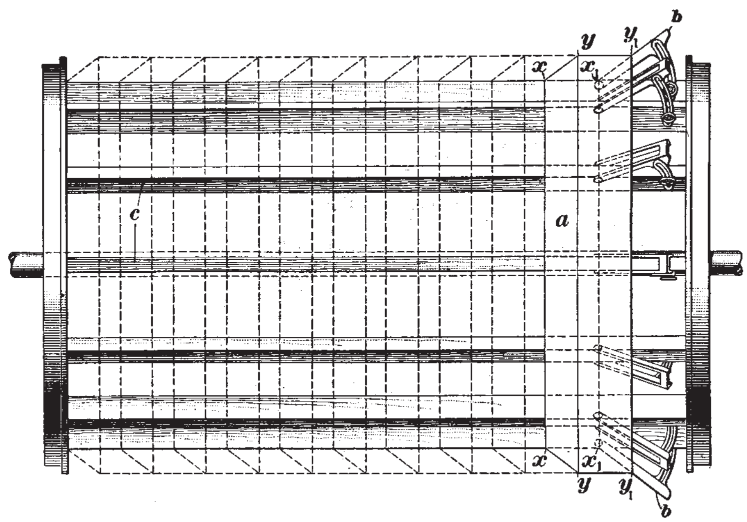

FIG. 12

section, so that each succeeding layer of the second section mounts the inclined or cone-shaped edge of the first section. After the completion of each section, the reel must be disengaged from the rack and moved back to the correct position for starting the next section.

The coning irons on the end of each bar are adjustable, so that the cone may be built at any angle to suit coarse or fine yarn. The pinion on the bottom of the vertical shaft may also be changed to alter the traverse of the reel while a given length of yarn is being reeled.

In beaming, or winding the yarn from the reel to the beam, the reel is revolved in the opposite direction, and the lateral motion of the reel therefore will be reversed, causing the outside threads to remain in line with the beam heads at all times.

LEASING

18. A **lease** is an arrangement of the threads of a warp by means of which the ends are kept in their proper position and entanglements and snarls prevented. A thread lease is one in which the individual ends of the warp are alternately passed above and below two rods or cords; this serves to keep the separate ends of the warp in their proper relative position, which is essential when the warp is being drawn through the harnesses and reed. A thread lease is obtained by means of the lease reed shown in Fig. 13. It is of peculiar construction; every alternate dent is filled with solder for a short distance at the top and also for the same distance at the bottom, thus leaving only the central part of the dent free.

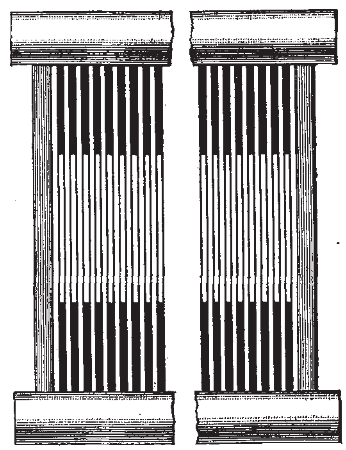

FIG. 13

After the yarn has been attached to the reel, it is first depressed by means of a stick close to the lease reed, thus forming a separation of the ends, owing to every alternate dent being soldered. A string is then run through this division, after which the yarn is raised by means of the stick and another string run through. As one thread is in each dent of the lease reed, this will form a thread lease. The strings, of course, must be placed in front of the condensing reed and securely tied. A lease should be taken when starting each section of the warp on to the reel, so that it will leave the reel at the last end of the warp when the yarn is beamed.

BEAMING

BEAMER

19. After a sufficient number of sections have been placed on the reel to form the entire warp, it becomes necessary to transfer the warp from the reel to the loom beam. The reel in this case is revolved in the opposite direction, and instead of being driven by the belt from the dresser, motion is imparted to it only by the tension of the yarn in being pulled off the reel and wound on the beam. It is necessary, in order to wind the beam with sufficient firmness, to place friction on the warp reel and to disconnect the driving mechanism. The ends of the warp are taken from the reel and attached to an apron that is tacked or otherwise fastened to the loom beam, or in some cases the warp is separated in bunches and tied to ropes or cords fastened to the beam. The beam is given a rotary motion by means of a simple machine known as the **beamer,** made to unwind the warp from the reel to the beam.

Fig. 14 shows an ordinary type of beamer, known as a **double beamer,** since it is designed to beam the warps from two reels at once, if desired, as it is possible to attach a beam to each side of the beamer, so motion will be imparted to both at the same time. The machine consists of a frame carrying tight-and-loose pulleys *a* on the main shaft. On this shaft is a gear *b* engaging with a gear *c* fast to an intermediate shaft. On each end of this intermediate shaft is a gear meshing with the large gears *d*, *e*; one end of the loom beam *f* is fastened to one of these large gears by means of adjustable dogs that fit in slots in the beam head. The other end of the beam is placed in a supporting bracket *g*, which is adjustable on a plate or slide *h* fastened to the floor, so that it may be adjusted for any length of beam. The

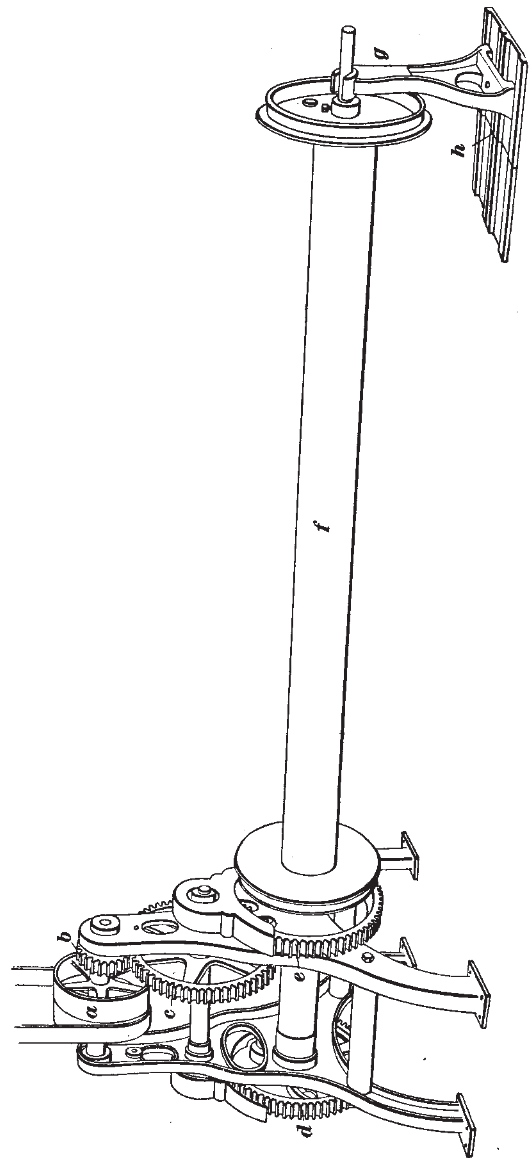

FIG. 14

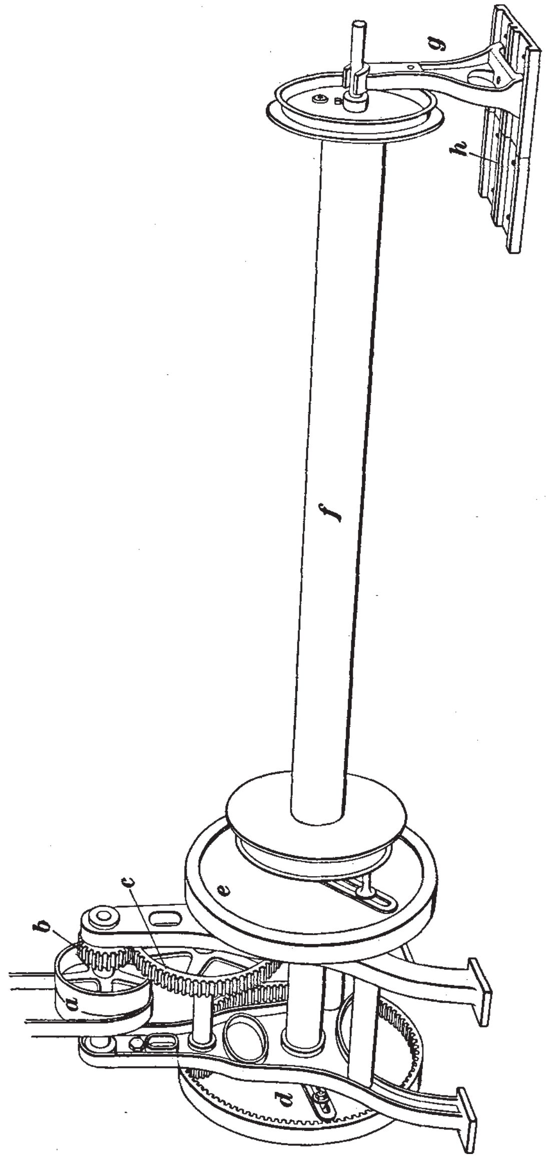

Fig. 15

belt is guided on the tight-and-loose pulleys by means of an adjustable belt guide, so that the belt may be guided to the pulleys from any direction. This belt guide is usually arranged to be fastened in position by means of a thumb-screw. By having the large gears *d*, *e* driven as shown, greater power is obtained, since it is transmitted by two gears instead of one. Guards are placed over these gears as a protection against accidents. Fig. 15 shows another type of double beamer. The only difference is that the gears *d*, *e* are annular gears instead of ordinary spur gears; this makes a very neat and powerful beamer.

The driving pulleys of a beamer are usually about 10 inches in diameter, and the gearing is such that a speed of 150 revolutions per minute of the tight pulley will give the loom beam a speed of about 8 turns per minute, which is sufficient for beaming warps.

A **single beamer** is made similar to a double beamer, except that it has only one gear to which a beam may be attached and is designed to beam the yarn from one reel only.

COMPRESSING WARPS

20. In the ordinary method of warp preparation, the yarn is constantly subjected to tension, both in being spooled and in being beamed from the warp reel to the loom beam, with the result that its elasticity is largely destroyed and the finished goods have a *hungry* appearance. The resulting fabric is hard and boardlike, lacking the full and elastic feel that is so greatly desired in high-grade woolen and worsted fabrics. Owing to the fact that the greater the tension placed on the yarn, the greater is the amount of yarn that can be placed on spools and beams, there is a tendency to increase this tension to such a degree that the elastic limit of the yarn is very nearly reached. Goods made from yarn that has been strained to a great extent in spooling, beaming, and weaving will shrink excessively after being finished; and garments made from such

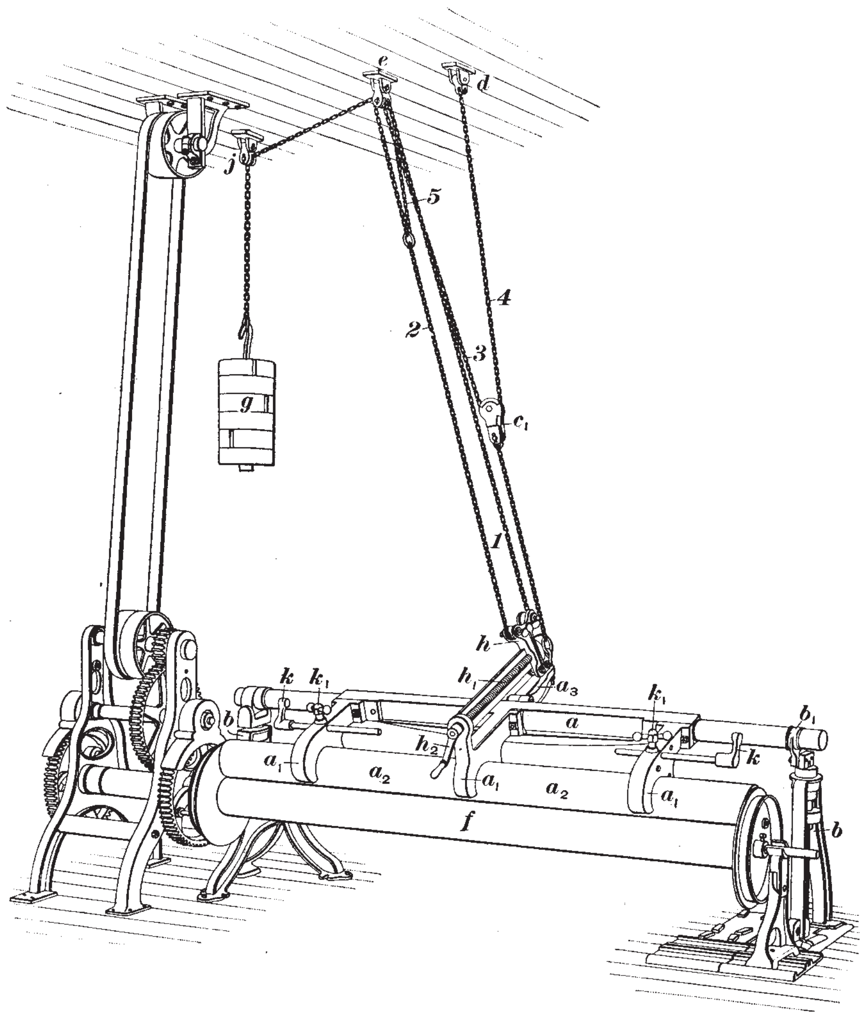

Fig. 16

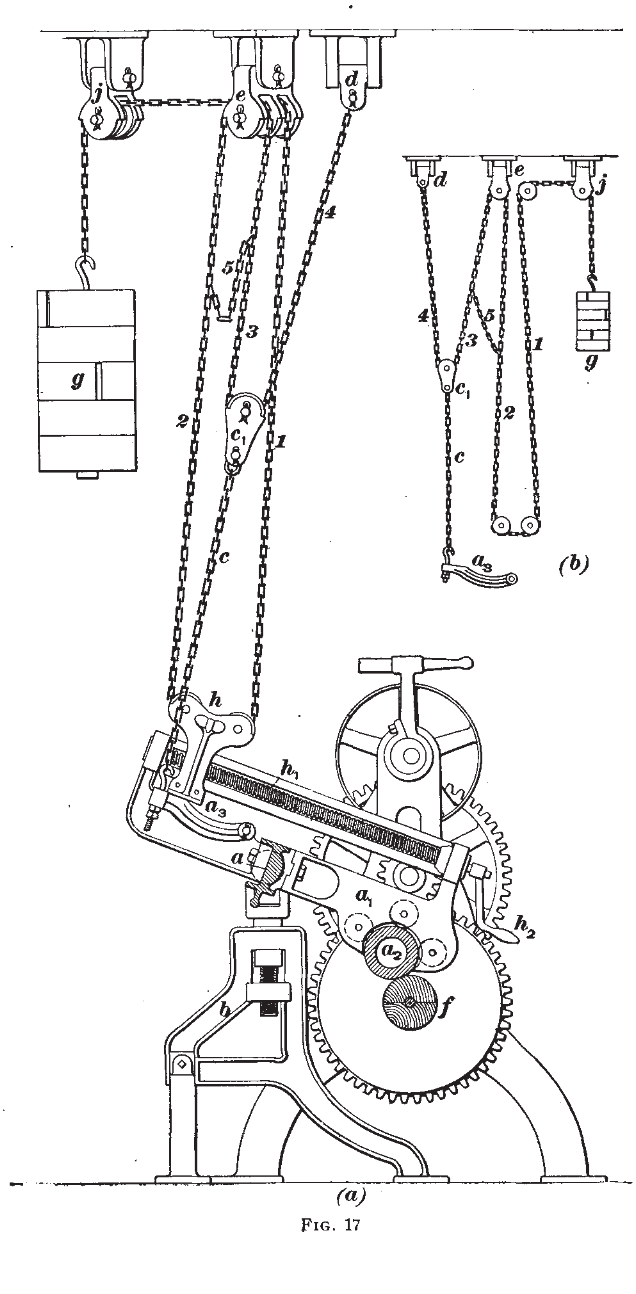

FIG. 17

goods, after being worn for some time, will shrink so that they are much too small for the wearer.

It is the object of the compressing system of warp preparation to substitute compression for tension at every point in the preparation of a woolen or worsted warp where it is practicable. The system applied to warps is the same as that adopted in the compressing spooler. By this system the warp is compressed as it is beamed, which results not only in the elasticity of the yarn being retained, but also enables from 20 to 50 per cent., and in extreme cases 60 per cent., more yarn to be placed on the beam. With this system the tension on the reel is reduced as much as is practicable and the required hardness of the beam obtained by a machine known as a *warp compressor*. Compressed warps will weave better and the cloth when finished will have an elastic feeling that cannot be produced in the ordinary way.

WARP COMPRESSOR

21. Fig. 16 shows a **warp compressor** in position for compressing a warp as it is beamed, while Fig. 17 (*a*) is a section of the same machine. The machine consists primarily of a compressing roll a_2 extending the full width of the loom beam f and resting on top of the yarn. This compressing roll is carried in roller bearings at the end of three arms a_1 fastened to a girder shaft a so constructed as to withstand the great transverse strain that is necessary in order to obtain sufficient pressure to compress the warp. The compressing roll is constructed of a piece of steel tubing 64 inches in length, and by means of 10-inch, 2-inch, 1-inch, $\frac{3}{4}$-inch, and $\frac{1}{2}$-inch sections, which may be added to the end of the roll and fastened securely by means of a screw; its length may be increased so that it will fit beams from 64 up to 104 inches in width. By having the sections of the different widths above stated, $\frac{1}{4}$-inch adjustments may be obtained, so that the roll will compress the warp on any beam between the above limits. The shaft a is carried in bearings supported by stands b, and the power for compression is obtained by means of a weight g, which is hung on a chain connected with the compressor.

The central arm, in which a bearing of the compressing roll is placed, is constructed somewhat differently from the other two arms as it extends behind the shaft a, which is the fulcrum of the compressing device. A screw h_1 mounted on this arm is turned by means of the handle h_2 and carries an adjustable block h, which contains two pulleys, around which passes a chain by means of which the compressing force is transmitted to the compressing roll. Attached to a lever a_3, loose on a stud in the arm a_1, is a chain c, to the end of which a block c_1 is attached. The weight chain is attached with one end to a casting d fastened to the ceiling and passes around the pulley in the block c_1, over a pulley in a double block e, then around both pulleys in the block h, over the other pulley in the block e, over the pulley in another block j, and has attached to its free end the weight g. While the warp is being compressed, the block h is screwed back to the position shown. Under these conditions the weight g acts through four lengths of chain *1, 2, 3, 4* so that the amount of power exerted at h and transmitted to the compressing rolls is equal to four times the amount of weight g; for instance, if the suspended weight g is 80 pounds, then 320 pounds is exerted at the end of the arm a_1.

When a new beam is to be started or a full one removed, the compressor may be readily raised out of the way by simply releasing the collar b_1 on the shaft a from the stand b, whereupon the weight g will lift the compressor on the swivel bearing at the other end of the shaft a and raise it out of the way. It will be seen, however, that in order to do this, it is necessary that there should not be too great a strain on the machine; otherwise, when the collar b_1 is released, the compressor will rise with such great force that it cannot be checked. In order to relieve the strain of the weight, therefore, a short length of chain *5* is inserted between lengths *3* and *2* of the chain. When it is desired to raise the compressor, the block h is screwed forwards; this allows the lever a_3 to rise and the short length of chain *5* to be tightened.

When this is done, the weight will act through only two lengths of chain—*1* and *2*—the loop formed by the short length of chain hanging over the pulley *e* and acting exactly as though it were simply fastened to it. The pressure exerted on the compressor in this case will only be one-half as great as that exerted while the warp is being compressed, so that the machine can be more easily handled. This arrangement is shown somewhat more clearly in Fig 17 (*b*). Two pieces *k*, Fig. 16, which may be fastened in any position by means of handscrews k_1, are used to hold the compressing roll from slipping out lengthwise when the compressor is raised.

FORMATION OF WARPS

PLAIN WARPS

22. To illustrate the simplest possible operation of making a warp, suppose that a plain warp containing three cuts of 72 yards each is required. The warp is to contain 2,400 ends plus 20 ends on each side for selvage and is to be beamed 56 inches wide, this being the width of the loom beam between the heads.

23. Spooling the Yarn.—The first operation is to find out how many spools will be needed for one section of the warp. Suppose that the creel behind the dresser will hold only twelve spools and that the construction of the spooler is such that 40 ends are placed on each spool. Then it will be impossible to use more than 480 ends (12 × 40) in one section of the warp. As the warp contains 2,400 ends, five sections can be used, which will give exactly 480 ends in a section. It will be necessary, therefore, to have twelve spools made, but the length of yarn to be placed on each spool must be ascertained. The warp is to contain three cuts of 72 yards each, or 216 yards in all, and as there are five sections of the warp to be run, then each spool will have to contain five times 216 yards, or 1,080 yards.

In order to be sure of enough yarn being left in the dresser for tying the next warp, several yards more should be wound upon each spool. It is not always possible to place sufficient yarn upon a spool to run the entire warp, in which case it will be necessary to tie in extra spools during the process of making the warp.

24. Tying in.—The term **tying in** is used to designate the operation of tying the yarn on the spools to the yarn that is left in the dresser from the last warp especially for this purpose. When the spools are made for a warp, it is always planned to have enough yarn left in the dresser to which the new spools for another warp can be tied and then drawn through the dresser, for it is quite a difficult task to draw the yarn through the tying-in reed *b* and the lease reed *n*, shown in Fig. 1, as it is necessary for each end of the section to pass from the tying-in reed through the dresser to the lease reed without crossing other ends; that is, each dent of the lease reed has a corresponding dent in the tying-in reed. It is necessary for the ends to be drawn through the dresser straight; otherwise, if a fancy pattern were arranged correctly at the tying-in reed, it would not be correct at the lease reed and, consequently, in the warp.

25. In the plain warp under consideration, after having obtained the twelve spools, it is next necessary to arrange for tying them to the yarn that is left in the dresser from the previous warp and that is cut off about $\frac{1}{2}$ yard in front of the tying-in reed *b*, Fig. 1. To do this, first count out 480 ends in front of the tying-in reed, as there are to be 480 ends in a section. Then, beginning at one end of the reed with the first end of the 480, cast it up over the top of the reed; then skip 11 ends and cast up another end, and so on for the full width of the reed. When finished, 40 ends ($480 \div 12$) will be cast up over the reed. These are then knotted together and left lying over the top of the reed, being the ends to which one spool will be tied. Then proceed in like manner for the other spools as follows:

For the second spool, take one end and skip ten.
For the third spool, take one end and skip nine.
For the fourth spool, take one end and skip eight.
For the fifth spool, take one end and skip seven.
For the sixth spool, take one end and skip six.
For the seventh spool, take one end and skip five.
For the eighth spool, take one end and skip four.
For the ninth spool, take one end and skip three.
For the tenth spool, take one end and skip two.
For the eleventh spool, take one end and skip one.
For the twelfth spool, take one end and skip none.

After the eleventh spool is picked up, the remaining ends will be for the twelfth spool.

The next operation is to tie in the spools. Take the last bunch of ends that was picked in the reed and to it tie the ends of the bottom spool in the creel. Then take the next spool and tie each end to an end of the bunch that was picked from the reed next to the last. When tying in each spool, the operation should be begun at the left of the reed and each end on the spool and in the reed tied in regular order; that is, no crossed ends should be allowed. After all of the spools are tied in, the friction boards should be placed on the spools and the yarn drawn through the dresser by carefully pulling on the yarn from the front of the machine.

Sometimes when left-twist yarn is tied on to right-twist, or vice versa, great difficulty is found in pulling the yarn through the dresser, since one yarn will untwist the other. Especially is this true if one yarn contains more twist than the other. When this happens it is sometimes best not to place any friction on the spools until the new yarn is drawn through the lease reed; and also to be very careful in pulling it through.

26. Reeding the Sections.—After the section is pulled through the lease reed, it is necessary to determine the width of each section in order to determine the number of ends that must be drawn in one dent of the **condensing**, or **hack, reed** so that the sections will be wound on the warp reel the required width. The warp is to be beamed 56 inches wide, which when divided by five sections gives 11 inches as the width of each section with 1 inch over. This 1 inch may be utilized by adding $\frac{1}{2}$ inch to the first and last sections for selvages, setting the pins so that these sections will be $11\frac{1}{2}$ inches wide on the warp reel, while the other three sections will be but 11 inches. Or, five sections 11 inches wide may be made and the selvages run outside of the pins. The width of the sections, of course, regulates both the width that the pins are set apart on the warp reel and also that of the section in the condensing reed.

Supposing that the condensing reed is a No, 15; that is, it contains 15 dents per inch. Then there will be 165 dents in 11 inches (11×15). If 480 threads, which is the number of ends in one section, are drawn 3 in a dent, they will occupy 160 dents, which is practically near enough; but by drawing only 2 threads in some dents, the sections can be made exactly 11 inches wide in the condensing reed. Each section, of course, is the same length on the reel, i. e., 216 yards, and after the reed has received the five sections it is only necessary to loosen the belts and place the friction on the reel, when the warp can be beamed. It is important to take a lease in the warp by means of the lease reed before reeling each section, as previously explained.

27. Selvages.—When winding the first section on the reel, 20 ends should be drawn through the lease and condensing reeds at one side of the section for selvage, but after the first section is wound they should be broken out and ignored until the last section of the warp is reeled, when they should be crossed over and drawn in on the other side of the section so as to form the selvage on the other side of the warp. These 20 ends for the selvage on each side may be run from bobbins that are placed on pins on the dresser.

FANCY WARPS

28. When a fancy pattern consisting of colored yarns is to be tied in, the operation of picking the ends for the spools is somewhat more difficult, since not only the spools but the pattern also must be considered. To illustrate the method of picking a fancy pattern, a pattern will be taken and the method described with reference to it. Suppose that a warp is to be made to contain 2,760 ends plus 30 ends on each side for the selvage; it is to contain five cuts, each 72 yards long, and is to be beamed 58 inches wide. The pattern of the warp is to be as follows:

WARP PATTERN

Black	20		20		20									10		10									80
Red		4				4							8		8		8		4		4				40
White				4				4				4						4		4					20
Brown							20		20		20											10		10	80
Fawn										4													6		10
Total number of ends in pattern																									230

29. Spooling the Yarn.—The first operation is to determine the number of warp patterns in one section of the warp and if (as in the previous case) the creel behind the dresser will contain only 480 ends, it is obvious that the section can contain only two patterns, or 460 ends (230×2). It is, of course, always necessary to have even patterns in each section of the warp; otherwise, there will be broken patterns in the finished warp, which will make it useless. As the warp is to contain 2,760 ends, there will be six sections in the warp ($2{,}760 \div 460$). It is always necessary to have the number of ends in the section divisible by the ends in a pattern and always best to have the number of ends in the warp (exclusive of selvage) divisible by the ends in a section, although it is possible when running the last section to break out some of the ends if they are not desired.

It is next necessary to find the number of spools of each color of yarn required and also the length of yarn that must be spooled. To find the number of spools of each color required in a fancy pattern:

Rule.—*Multiply the number of ends of each color in one pattern by the number of patterns in a section and divide by the number of ends on one spool (generally 40). The result in each instance will be the number of spools required of that particular color.*

Applying the above rule to the pattern under consideration,

$$\frac{80 \text{ ends} \times 2 \text{ (patterns)}}{40} = 4 \text{ spools black}$$

$$\frac{40 \text{ ends} \times 2 \text{ (patterns)}}{40} = 2 \text{ spools red}$$

$$\frac{20 \text{ ends} \times 2 \text{ (patterns)}}{40} = 1 \text{ spool white}$$

$$\frac{80 \text{ ends} \times 2 \text{ (patterns)}}{40} = 4 \text{ spools brown}$$

There are only 10 ends of fawn in one pattern or 20 ends (10×2) in one section. There are not enough for a full spool but it will be better to wind them on a spool and run them with a little less friction on that spool rather than to run them from bobbins, although this can be done. There are 12 spools ($4 + 2 + 1 + 4 + 1$), therefore, required for the section, which will just fill the creel at the back of the dresser.

30. It is next desired to find the number of yards to be spooled in order to make a warp of the required length. To find the number of yards to be spooled:

Rule.—*Multiply the number of cuts of warp by the length of a cut and by the number of sections in the warp.*

Applying the above to this particular pattern gives the following result:

$$72 \text{ yd.} \times 5 \text{ (cuts)} \times 6 \text{ (sections)} = 2{,}160 \text{ yd.}$$

From this it will be seen that there are 2,160 yards of each color required, with several yards extra to be left in the dresser for the next pattern. Unless the pattern consists of very fine yarn, this length cannot be spooled on a single spool and must therefore be wound on two or more spools, thus necessitating an extra tying in before the warp is finished. In this connection, however, it should be noticed that a single spool of fawn can be spooled containing the full number, or 40 ends, but only half the length, thus allowing 20 ends to be dressed first and afterwards the next 20 ends without removing the spool from the dresser creel.

The spools of different colors being obtained, the fawn will be placed in the bottom of the creel, then the brown, white, and red, finishing with the black in the top of the creel.

31. Picking a Fancy Pattern.—Having decided on 460 ends in the section, it is now necessary to count out 460 ends from those in the tying-in reed, after which the pattern can be picked as follows: Beginning at the left-hand end of the tying-in reed, or rather of the 460 ends counted, first pick the black, or top, row in the pattern. Pick 20 ends, then skip 4 ends for the red; then pick 20 ends and skip 4 ends for the white; pick 20 ends and skip 84 ends for the red, white, brown, and fawn, as shown by the pattern; then pick 10 ends and skip 8 for the red; then pick 10 and skip 50 ends for the other colors. As the section contains two repeats, it is necessary to repeat this operation. When this is finished, there will be 160 ends, which should be knotted together and cast over the top of the tying-in reed. These ends are the ones to which the black yarn will be tied.

It is next necessary to pick the ends for the red, which is done as follows: Beginning at the left, pick 4 ends and skip 4; pick 4 and skip 72; pick 24 ends (the black has already been thrown over the top of the reed) and skip 4; pick 4 and skip 4; pick 4 and skip 26. This operation is, of course, repeated as when picking the black.

The white is then picked as follows: Beginning at the left, pick 4 and skip 20; pick 4 and skip 44; pick 12 (the red and black are already cast over the reed) and skip 26. Repeat this operation as many times as there are repeats of the pattern in the section.

The brown is picked as follows: Beginning at the left, pick 40 and skip 4; pick 30 and skip 6; pick 10. Repeat this operation twice. The ends remaining in the reed, that is, those that are not cast over the top, will be the ends to which the fawn is to be tied.

Many dressers pick a pattern from right to left of the draft and work from right to left of the tying-in reed.

32. Tying in a Fancy Pattern.—The pattern is now picked, but as each spool is tied in separately, there is one more point that must be considered; that is, the dividing of the yarn that has been cast up for each color into sections of 40 ends each. This is done by taking each bunch of threads representing one color and picking out 40 ends as many times as possible. These 40 ends are then knotted together and thrown over the reed. It is not necessary to take these ends in any particular order, since the same color of yarn will be tied to each of them, but simply to make a selection of ends for each spool extending across the full width of the reed.

For instance, in this pattern all the ends will be thrown down and the bunch of 160 ends representing the black yarn will be picked up and 40 ends selected for each spool, each selection being made somewhat at random, but still selected so that the ends from each spool will be spread across the width of the reed. The ends for each spool can, however, be picked after the same manner as a plain warp if it is desired to have the yarn absolutely straight. The same operation is then carried out with the bunches of yarn to which the other colors are to be tied, and after completion the ends are thrown back over the reed, the ends for each spool being knotted together.

The section is now ready to be tied in, which is accomplished as follows: Take the first bunch of ends laid over the reed, which of course will be the last color picked, or the 20 ends of fawn, and tie each end to the ends of fawn on the bottom spool in regular order. There will, of course, be only 20 ends taken from this spool. Then take the next bunch of threads and tie in the next spool, which is brown. This operation is continued until all the spools are tied in, remembering to tie each bunch of threads to its proper color; thus, in this pattern they will be tied in the following order, commencing at the bottom of the creel and working up: 20 ends of fawn on one spool, four spools of brown, one spool of white, two spools of red, and four spools of black.

33. Reeding the Sections.—After the spools are tied in with secure knots, the method of making the warp is the same as that employed in making a plain warp. As the warp is to be beamed 58 inches wide and contain six sections, four sections will be made $9\frac{1}{2}$ inches wide and the two end sections, which contain selvages, will be 10 inches wide. These widths regulate the setting of the pins on the reel. Suppose that the condensing reed is a No. 12. In $9\frac{1}{2}$ inches there will be 114 dents, while 460 ends, if drawn 4 in a dent, will occupy 115 dents. This is only 1 dent out of the way, which is near enough for practical purposes, although the section may be made to occupy exactly 114 dents by drawing 5 ends in 4 of the dents of the reed. The selvages, of course, will be drawn in as previously explained and the sections leased and then reeled, each section being 360 yards long (72×5).

SUMMARY

34. The following is a summary of the calculation of this fancy pattern and shows the data that the boss dresser will have collected for making the warp. The pattern of the warp is shown in Art. **28**, while the figuring is as follows: 230 ends $\times$ 2 (patterns) = 460 ends in section; 460 ends $\times$ 6 (sections) = 2,760 ends in warp; 30 ends on each side for selvage; [80 ends $\times$ 2 (patterns)] $\div$ 40 = 4 spools of black; [40 ends $\times$ 2 (patterns)] $\div$ 40 = 2 spools of red;

[20 ends × 2 (patterns)] ÷ 40 = 1 spool of white; [80 ends × 2 (patterns)] ÷ 40 = 4 spools of brown; 10 ends × 2 (patterns) = 20 ends of fawn; 72 yards × 5 (cuts) = 360 yards, length of each section; 360 yards × 6 (sections) = 2,160 yards of each color spooled; 58 inches wide on the beam; 4 sections, 9½ inches wide on the reel; 2 sections, 10 inches wide on the reel; 9½ inches in condensing reed; 4 ends per dent (5 ends in 4 of the dents).

On many fancy patterns considerable ingenuity must be exercised and often colors must be run from bobbins. Sometimes, when only a few threads of some colors are used, these colors can be wound together on one spool. However, no specific rules can be laid down for these items, since it may be said that no two fancy patterns are formed in the same manner

DRAWING IN AND REEDING

DRAWING IN

35. After a warp has been beamed it must first be drawn through the heddles of the loom harnesses, according to the drawing-in draft, and afterwards through the reed, according to the reeding particulars furnished by the designer. These operations complete the preparation of the warp and it is then ready to be placed in the loom and woven.

The **harness**, Fig. 18 (*a*), is a wooden frame attached to the shedding mechanism of the loom by means of which it may be raised and lowered to form an opening, or shed, in the warp through which the shuttle carrying the filling yarn can be thrown. At the top and bottom of the harness frame two steel heddle bars a_1, a_1 are placed; these bars are usually fastened at one end by means of threaded stretcher hooks and nuts, while at the other end they pass through a slot in the harness frame and are secured by hooks that engage with holes in the heddle bars. Heddles, Fig. 18 (*b*), twisted from wire are threaded on the heddle bars, and in addition to the eyes required at each end for this purpose are made with an eye at the center through which an end of the warp may be drawn. Any reasonable number of heddles may be placed on the harness frame, the number required depending on the number of ends in the warp and the number of harnesses to be used. The drawing-in draft also may require more heddles on some harnesses than others, but extremes should be avoided, since if the heddles are too crowded the warp will run poorly in the loom. When the harnesses are very wide, hooks a_2, Fig. 18 (*a*), are inserted in the frame to support and stiffen the heddle bars.

36. Drawing-In Frame.—In order that the warp may be drawn through the harnesses in the most convenient

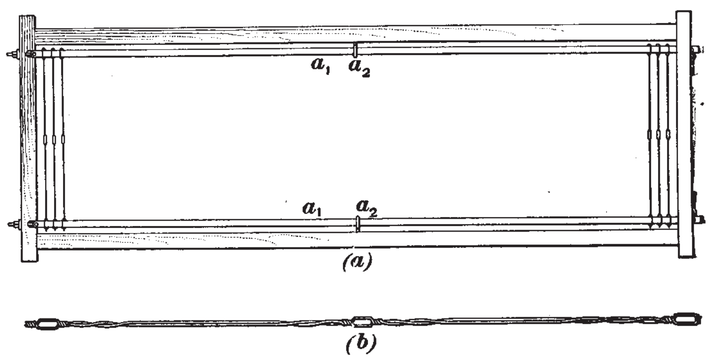

FIG. 18

manner, a drawing-in frame similar in principle to that shown in Fig. 19 is necessary. An iron drawing-in frame may be purchased, but it is usual for the mill to construct its own drawing-in frames, since a very simple arrangement is all that is necessary. As shown in Fig. 19, the essential features are two stands *a* for supporting the beam and a framework *b* over which the warp may he drawn. The two arms b_1 bolted to this frame support the harnesses, while the lease of the warp hangs from the supporting beam b_2 directly behind the heddle eyes of the harness. The strings that have retained the lease in the warp are replaced by two lease rods *c* that are placed through the lease and tied together at each end, after which the lease strings may be withdrawn.

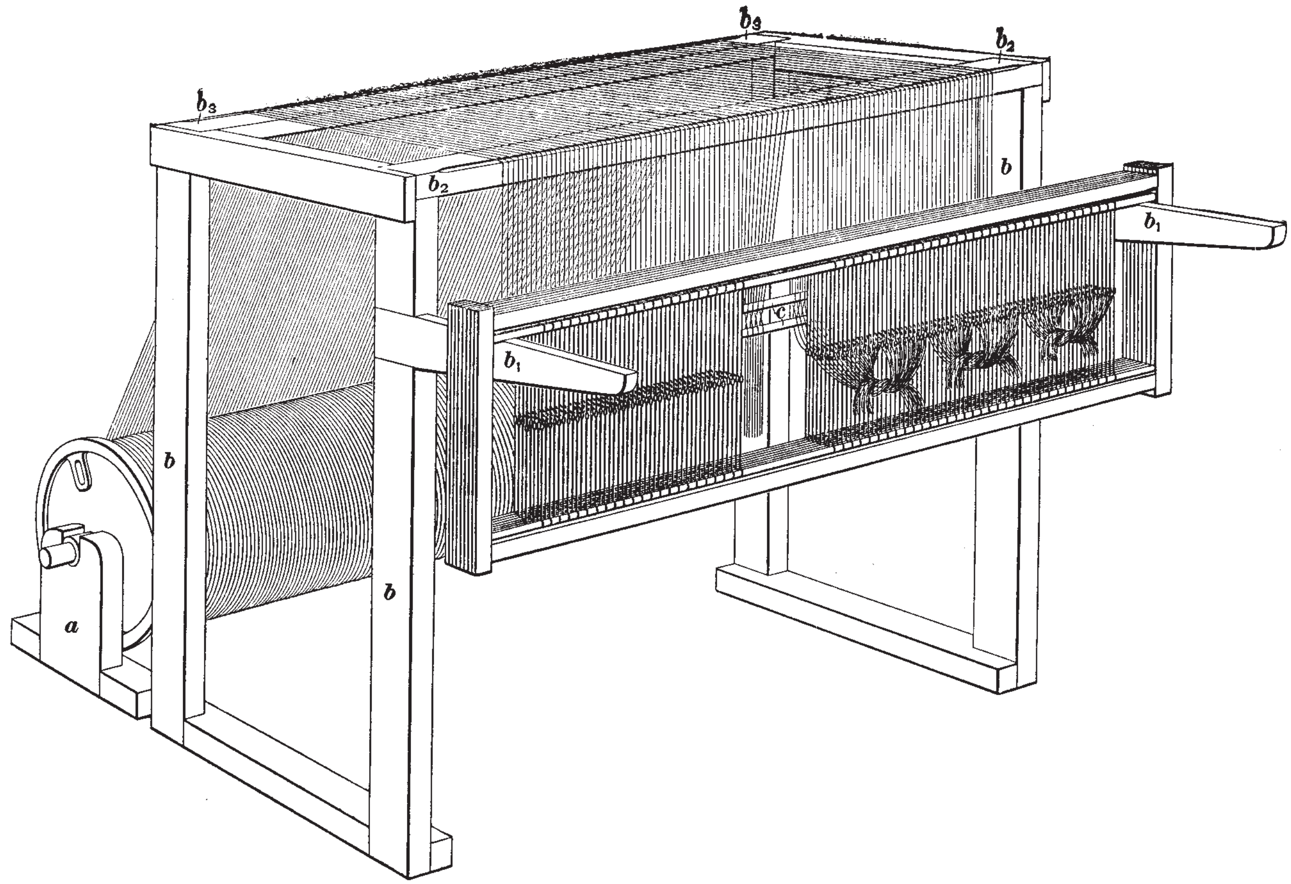

Fig. 19

37. Method of Drawing in a Warp.—The operation of drawing in a warp is as follows: The order in which the ends are to be drawn through the harnesses is usually indicated by a draft similar to that shown in Fig. 20, furnished by the designer. In this draft the horizontal rows of squares represent the harnesses as indicated, the draft being made in this case for a warp that is to be drawn in on eight harnesses. The vertical rows of squares indicate the warp ends, and the figures on these vertical rows of squares indicate through which harness each end is to be drawn. When drawing in, the operator commences at the right of the warp and of the harness frames and draws in the first end of the warp on the harness indicated on the first vertical row of squares at the right of the drawing-in draft. This operation is then repeated

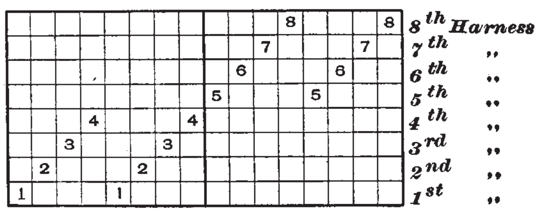

FIG. 20

with the next end, and so on, the warp being drawn from right to left. For instance, according to the draft in Fig. 20, the first end of the warp on the right will be drawn through the eighth, or back, harness, the second end through the seventh harness, the third end through the sixth harness, the fourth end through the fifth harness, the fifth end through the eighth, and so on throughout the draft. When the last end of the draft is drawn in, the whole operation is repeated, commencing again at the right of the draft. When the ends are drawn through the harnesses in regular order from back to front or front to back, the draft is said to be a *straight draw*, but when the ends are drawn in any other order, the draft is is said to be a *cross-draw*. The operation of drawing in is generally performed by a girl, called a *drawer-in*, and in cases where a large number of harnesses are used or where the drawing-in draft is quite complicated, another girl, called a *hander-in*, assists. The drawer-in grasps the required heddles in her left hand and inserts a hook, called a *reed*, or *drawing-in, hook*, Fig. 21, in the eye of the heddle, while the hander-in hooks the required thread, as indicated by the lease, in the eye of the hook; the drawer-in then draws the thread through the heddle eye and inserts the hook in the next heddle, and so on. The drawer-in sits in front of the harness frame, Fig. 19, while the hander-in sits in the rear,

FIG. 21

underneath the yarn; this is the reason for building the drawing-in frame with two bars b_2, b_3 over which the warp is passed. In cases where no hander-in is required, the drawing-in frame may be constructed with only one bar b_2. As fast as a number of ends are drawn through the heddles, the drawer-in makes two bunches of the yarn and ties a half knot in front of the heddles so as to prevent the ends from being accidentally pulled out.

REEDING

38. After the ends of the warp have been drawn through the harnesses they must be drawn through the **reed,** which is a gratelike device placed in the lay of the loom for the purpose of beating up each pick of filling as it is inserted in the cloth; it also separates and distributes the warp ends across the width of the cloth. A reed is constructed of thin, flat strips of steel set edgewise in two pieces of wood called **ribs,** as shown in Fig. 22. Each rib is made in two parts that are wound with waxed cord in order to space the strips and make the whole reed firm. The space between two adjoining strips of steel in the reed is called a **split,** or **dent,** the latter being the term generally employed. The number of dents in a given space is largely determined by the size of the waxed cord with which the ribs are wound, since the thicker the cord, the greater will be the space between the strips. The number of dents in a given space determines the number of the reed. The general custom is to use for this given space 1 inch; thus, a 10s reed contains 10 dents per inch. In the English woolen trade $\frac{1}{4}$ yard, or 9 inches, is sometimes used; thus a 90s reed of this system is the same as a 10s reed of the American system. Sometimes, especially in the cotton trade, the number of dents in a given number of inches is used to designate the number of the reed; thus, a 1,200 — 30 reed, which indicates that there are 1,200 dents in 30 inches, is equal to a 40s reed. The height of the reed, or the length of the steel strips measured between the ribs, is governed by the class of fabric to be woven and the kind of loom for which it is designed. For instance, for cotton a $3\frac{1}{2}$-inch reed is high enough, while woolen and worsted require from a $4\frac{1}{2}$- to a 6-inch reed. Carpets and other heavy fabrics often require as high as from 8 to 9 inches. The coarser the reed, the less friction to a certain extent will there be on the warp; on the other hand, the finer the reed, the smoother will be the fabric. Reeds that have become bent or otherwise damaged by careless handling produce stripes in the cloth, known as **reed marks,** owing to the imperfect spacing of the warp. Sometimes if too many of the warp ends are drawn in one dent of the reed they will roll or ride each other. This may be remedied by using a finer reed and drawing less ends in one dent.

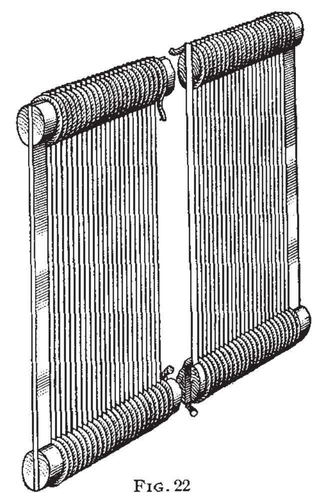

FIG. 22

Reeding is usually accomplished by means of a hook somewhat different from the one employed in drawing a warp through the harnesses, as shown in Fig. 23. The hook is passed through a dent of the reed and a number of ends, depending on the number to be drawn through this particular dent, are engaged and drawn through the reed as the hook is withdrawn. The hook is then inserted in the next dent and the ends drawn through in a similar manner. The number of ends drawn through a dent of the reed may vary in different cases, and sometimes with the same warp the reeding particulars may call for a different number of ends in some of

Fig. 23

the dents; but in any case the ends must be reeded in the same order as they are drawn through the harnesses. When reeding, the operator works from right to left in the same manner as when drawing in the warp, and ties the warp in half knots in front of the reed so that there will be no danger of the ends being pulled out of the reed.

TWISTING IN

39. After a warp has been nearly woven out in the loom, if the new warp that is to replace it has the same number of ends and is to be woven with the same drawing-in draft, considerable time and labor may be saved by twisting it in. When this can be conveniently performed in the loom, a lease is made in the old warp by raising every alternate harness and inserting one lease rod, and then depressing these harnesses, raising the others, and placing another rod in the shed. This forms the lease, which facilitates the twisting in of the ends in their proper order. The new warp is then placed in the loom and the ends twisted to those of the old warp. This is done by taking the threads of the two warps in the proper order with the right hand, and taking out the twist with the left hand, and then laying back the two ends and rolling them firmly together. Each end of the new warp is twisted to the corresponding end of the old warp in this manner, and the new warp is then carefully drawn through the harnesses and reed. While the twist is not sufficiently strong for weaving, it is strong enough to enable the new warp to be drawn through the harness and reed without difficulty if care is taken. When twisting in, the operative generally dips his fingers in whiting and oil, which allows the threads to be more firmly secured.

40. Twisting-In Frame.—When it is not convenient to twist in the new warp in the loom, a frame, made especially for the process of **twisting in,** must be provided. This frame, Fig. 24, consists of stands *a* for supporting the warp beam *c*, and a stand *b* for carrying the harnesses *d* and the reed *e*, which is usually tied to the harnesses in order that it may be held securely in place. The old warp is cut out of the

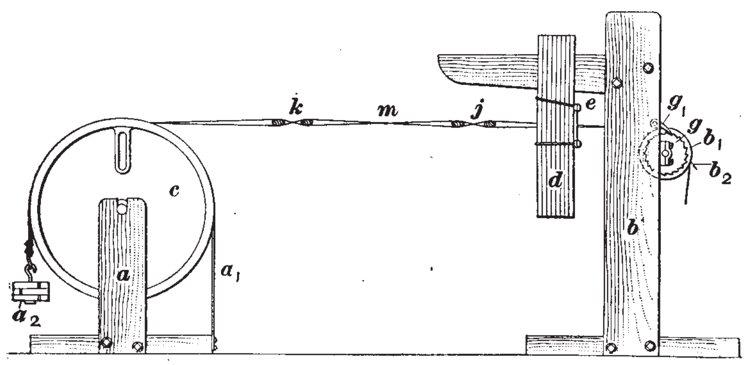

Fig. 24

loom, after a lease *j* has been taken, with a small piece of the woven cloth attached. This cloth is secured to a drum b_1 by means of pins b_2. A ratchet *g* and pawl g_1 prevent this drum from turning and slackening the warp while it is being twisted in. The new warp having a lease at *k* is placed in its stands and each end twisted to an end of the old warp at *m*. A strap a_1 and weight a_2 prevent the beam from turning. After the warp is all twisted, the friction is taken off the beam and the drum b_1 rotated until the new warp is drawn through the harnesses and reed, after which the old warp is broken. The ends of the new warp may now be knotted loosely in front of the reed and the warp placed in the loom.